COTTON CULTURE IN THE SAN JOAQUIN VALLEY IN CALIFORNIA

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COTTON was grown in the San Joaquin Valley about half a century ago, but was abandoned after a few years on account of labor and transportation difficulties that made it impossible to compete with the production of short staples in the eastern cotton belt. The industry is now being reestablished on the basis of new varieties and cultural methods, not brought from the eastern cotton belt, but developed in other irrigated valleys of southern California and Arizona.[1] After several years of experience it is believed that the Pima[2] long-staple cotton can be grown in the region of Bakersfield and Fresno to the same advantage as in the Salt River Valley of Arizona. With less extreme conditions of soil and climate, the cultural requirements are somewhat simplified in the San Joaquin Valley. There is less difficulty in keeping the young plants from growing too large, but the same need of giving enough water after the fruiting stage has been reached. Experiments in local adaptation are needed, but satisfactory results may be claimed for the methods here described. Even in short seasons, and with a very early frost in 1919 and 1920, the Pima variety has yielded more than a bale per acre in fields that were well grown.

CHOICE OF VARIETY.

Choice of varieties is the first question to be met, especially in districts where cotton is a comparatively new crop, as in the San Joaquin Valley. The only way of determining which variety is best adapted to a particular district is by actual comparison of the

[1] Cook, O. F. Extension of cotton production in California. U. S. Dept. Agr. Bul. 533, 16 p. 1917.

[2] Pima is a variety of Egyptian cotton which was bred by the Bureau of Plant Industry and is now being grown extensively in the Salt River Valley in Arizona.

different varieties under the local conditions. Such comparisons have been made for the last six years by the United States Department of Agriculture, with the result that the Pima Egyptian cotton has proved well suited to the greater part of the southern end of the valley, including Kern County northward to Fresno and Madera Counties, with the possible exception of the Tulare Lake district, where the cotton seems to be somewhat later in starting in the spring. It is doubtful whether the Pima variety can be grown successfully from year to year far north of Madera County, but the Durango and other varieties of Upland cotton may be grown as far north as Turlock, in Stanislaus County.

In districts where the Pima variety can be grown successfully there is little need of considering other varieties, as the territory in the United States in which this superior type of cotton can be grown is limited to the hot irrigated valleys of the Southwest, and the outlook is better for it than for any of the Upland or short-staple varieties. This circular is devoted principally to the growing of Pima Egyptian long-staple cotton in the San Joaquin Valley, although the same methods are applicable to such long-staple Upland varieties as the Durango and Acala, which are preferable for short-season districts.

ACREAGE.

Many farmers make the mistake of planting too much cotton. In many cases the entire acreage is cotton, making the farmer entirely dependent upon this crop for his annual income, which is bad practice for several reasons. The water supply may prove inadequate, as cotton needs heavy irrigations during July and August, whereas part of the land may be used for other crops that will not require as much water in the summer. The farmer who begins with a small acreage of cotton usually exercises more care and gives more attention to details, watches his crop more closely during the critical periods, picks his cotton cleaner, and receives a better price. With a small acreage of cotton grown in rotation with other crops, the grower is less dependent upon outside labor.

COTTON AS AN INTERPLANTED CROP.

In many districts cotton is gaining favor as an interplanted crop, especially in young orchards and first-year vineyards. In 1918 a farmer in Kern County planted cotton between young apricot trees which were making their third-year growth, and from about 2 acres of orchard land he obtained nearly $500 worth of cotton. The cotton occupied only 1.27 acres of the entire plat. In addition to paying for the upkeep charges of this orchard there was a balance of profit. Another farmer in the same county in 1919 set out 12

acres to Sultanina (*Thompson Seedless*) grapevines and interplanted with two rows of Pima cotton between each two rows of vines, from which he obtained a yield of nearly a bale per acre. At the end of the season the vines were in a very vigorous condition, only one being lost in the entire acreage. The system of interplanting cotton in young vineyards and orchards was so profitable in 1919 that many farmers adopted it in 1920, and there were many instances where cotton planted in two rows between each two rows of young vines yielded nearly a bale per acre. The quality of the cotton is as good as when grown alone, and grape experts claim that the young vines are in every way equal to those grown without an intercrop.

SELECTION OF LAND.

As to type of soil, it may be said that any soil that will grow good crops of alfalfa and other deep-rooted field crops will grow good cotton. A medium sandy loam is the ideal type, since it is more easily worked and holds water readily, though large yields have been obtained from both the extremes of sandy and heavy land. Cotton will stand a small amount of alkali, but should never be recommended for alkaline or hardpan soils. If the hardpan is nearer than 3 feet to the surface, the roots do not develop normally and more water is required.

On good land when the plants are well grown, the bolls are larger, picking is easier, and the fiber of better and more uniform quality. Many farmers have the idea that land which has been in alfalfa or pasture for several years should not be planted to cotton. Contrary to this belief, the highest yields of cotton in the San Joaquin Valley have usually been obtained from fields previously in alfalfa. Ordinarily less water is required to grow a crop of cotton on alfalfa land, and for this reason more precaution is necessary in applying irrigations, to avoid too luxuriant growth.

LEVELING LAND.

More important than the particular type of soil is the slope or grade, sometimes referred to as the "lay" of the land. The exact grade to be given the land will depend somewhat upon the type of soil, a steeper grade being possible on the lighter soils where water is readily absorbed. For the best results the land should be nearly level, because then the control of irrigation water is an easy problem and at the same time less water will be required than on land having a steep slope. In the San Joaquin Valley nearly all the cotton is grown under pump irrigation, with small heads of water carried in furrows, which makes it less important that the land be uniformly leveled in more than one direction. But this at least must not be

neglected or satisfactory control of irrigation water is out of the question. With imperfect leveling the seed may fail to germinate in some parts of the field or the plants may be stunted by drought, while other parts of the same field are overwatered, which causes a too luxuriant growth of the plants, later opening of the bolls, greater damage from frost, and more difficult picking.[3] Even when goods stands are established the fields that are not properly leveled will dry out in spots during the summer, and in order to avoid injury to both yield and quality it will be necessary to irrigate these spots separately, thereby causing much extra expense for water and labor.

PREPARATION OF LAND.

The preparation of land for cotton depends largely upon what crop was grown the preceding year.

In preparing land which was previously planted to milo it is best to plow it early in the fall or winter, covering the old stalks several inches deep. It is not necessary to harrow at this stage; in fact, it is best to leave the soil in the rough, to absorb the rain that falls during the winter and spring. Then, just before planting time, irrigate so as to saturate the soil thoroughly. It is unnecessary to plow again before planting, else the soil will dry out too deeply. A disk harrow is preferable on the heavier types of soil, but on the sandy soils a spring-tooth harrow seems to give very satisfactory results in that it does not stir the soil to too great a depth, and a firm, moist seed bed is highly desirable.

Many farmers find it rather difficult to grow cotton on land that has previously been in alfalfa if the alfalfa roots are not killed before planting the cotton. However, fairly good results in destroying the roots have been obtained by either of the following methods: One is to disk the alfalfa stubble in both directions and after a few days follow with a big plow, turning the stubble completely under. Allow the land to lie with the alfalfa roots exposed to the sun for a few weeks before watering. Another method is to plow the land 2 or 3 inches deep in the fall, allowing the roots to be exposed to the sun, then cross-plow in the spring to a depth of 6 or 7 inches.

Land that was previously planted to cotton should be prepared just as soon as the crop is harvested, though this is often not until January. A stalk cutter should be used to chop the stalks into small pieces; then the land should be plowed to a depth of 6 or 8 inches, completely covering all of the plant material, so that it will not interfere with further cultivation. Irrigation water may be applied at any time during the winter, because it is hard to put too

[3] Scofield, C. S., Kearney, T. H., Brand, C. J., Cook, O. F., and Swingle, W. T. Production of American Egyptian cotton. U. S. Dept. Agr. Bul. 742, 30 p. 1919.

much water into most of the soils of the San Joaquin Valley, but it must be remembered that a thorough irrigation is necessary just before planting time, to fill the soil to a depth of 4 or 5 feet and store as much water as possible for the summer requirements. Further preparation is with the disk or spring-tooth harrow, followed by a drag or smoothing harrow, leaving a well-pulverized seed bed. Planting should follow as soon as practicable, so that the seed can be placed in a well-moistened soil. Too much emphasis can not be laid upon the importance of preparing a good seed bed. All the work done during the winter and spring in leveling, plowing, and irrigating will be more than repaid during the following season, as it will require less labor and expense to care for the crop and the yield is certain to be larger.

PLANTING.

In most of the San Joaquin Valley, planting should be done between April 1 and 20, or as soon as possible after the danger of spring frosts is past. Fairly good results have been obtained from Pima cotton planted as late as May 10, but success depends on having a long season, and the risk increases the later the planting is done. Early planting is desirable not only to obtain the advantage of the longer season, but because the young plants are likely to show more normal habits of branching and fruiting if hot weather is not encountered during the early stages of growth.[4]

Satisfactory results may be obtained with either a 1-row or a 2-row planter, though the latter is preferable, because a more uniform depth of planting can be had. (See figs. 1 and 2.) Other advantages are the saving of time and making straight rows, which are very essential for the most efficient cultivation.

To insure a good stand of cotton it is advisable to use 20 to 30 pounds of seed to the acre. Under ordinary conditions 25 pounds will give satisfactory results. Some cotton growers plant only 12 to 15 pounds of seed, and a few get fairly good results, though most of them would make a great deal more cotton by planting more seed.

The larger quantity of seed has two important advantages: One is that there are more plants to help break any crust which may form on the surface and the other that it gives a better stand and permits more regular spacing, even when some of the seedlings are destroyed by insects.

Many farmers in the San Joaquin Valley space their cotton rows 4 feet apart, and the best fields have been grown in this way, but on the lighter soils 42 to 44 inches is sufficient. The wider rows are recommended, so as to permit the sunlight to reach the bottom of

[4] Scofield, C. S., Kearney, T. H., Brand, C. J., Cook, O. F., and Swingle, W. T. Op. cit.

the plants even when they grow rather large, as is usually the case on fertile soil with plenty of water. The desired number of plants per acre can be maintained by leaving them closer together in the row.

Attention should be called to the importance of using only the very best seed for planting. Farmers should first make sure that the strain is pure—that is, not crossed or mixed with other varieties of cotton—and then should give attention to the maturity and cleanliness of the seed. Seed from cotton that was forced open by frost should not be used for planting, as the percentage of germination is low. It is often advisable to reclean or delint much of the seed for planting; this, however, depends largely upon the efficiency of the ginning.

Except in very heavy soils, flat planting is to be recommended, using a special shoe or lister attachment to push away dry soil and

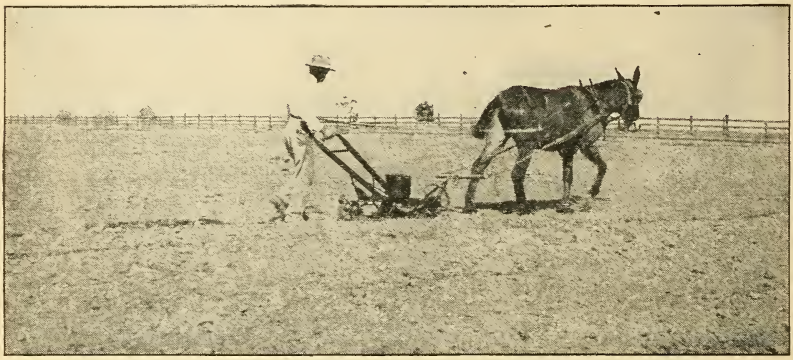

FIG. 1.—A 1-row cotton planter.

make a desirable seed bed. This device is very simple and easily made, either of wood or of iron. It fits down over the original planter shoe and is readily adjusted so as to allow the seed to be covered to a uniform depth. The loose, dry surface soil is pushed back and the seed placed in moist earth.[5]

In cases of extremely heavy soil it is sometimes advisable to plant on a ridge thrown up with a lister. Just before planting, water should be run between the rows to moisten the ridges by subirrigation. Then with a heavy board or drag the tops of the ridges are smoothed off, so that the seed can be planted in moist soil. This method permits a subsequent irrigation without flooding water over the tops of the rows, thereby causing the heavy soil to bake around the young plants.

[5] Hastings, Stephen H. A lister attachment for a cotton planter. U. S. Dept. Agr., Crop Physiol. and Breeding Inves. Cir. 2, 3 p., 1 fig. 1917.

Under normal conditions the seed should be covered 1 to 2 inches deep. If conditions are ideal and the soil rather heavy, 1 to 1½ inches may be sufficient, but on the average type of sandy loam soil which prevails in the San Joaquin Valley 1½ to 2 inches is better. It should always be borne in mind that the seed must be placed in and covered with moist soil, so as to insure prompt germination, though with the shoe attachment this is an easy matter. Under no conditions, however, should the seed be covered more than 2 inches, as the young seedlings are unable to push through when covered much deeper than this. In 1920 much damage was caused in the San Joaquin Valley by planting too deep. Many fields had to be reseeded entirely and others suffered severely by not obtaining

FIG. 2.—A 2-row cotton planter.

a uniform stand. Flooding the land after planting in order to germinate the seed is not advisable, because even in sandy soils a crust usually forms, and it is very difficult for the young plants to break through.

CULTIVATION.

Cultivation should begin as soon as the plants are well out of the ground, so as to break any crust which may have formed, to allow the soil to warm up around the young plants, and to kill the weeds; but the first cultivation should be shallow, because some soils will dry out as deeply as they are stirred. It is often possible to make the first cultivation with a drag or spike-tooth harrow, thus saving a great deal of time and labor. A disk cultivator is often found very satisfactory for the first one or two cultivations, especially on trashy land, but small shovels and sweeps are better for the later

cultivation, because they will kill more weeds and at the same time leave the land in better condition for irrigation and the next cultivation.

Just as soon as the plants have reached a sufficient height so that there is no danger of their being covered up, the soil should be gradually worked toward them at each cultivation, in order to cover any weeds that may appear in the row and at the same time throw up a small ridge along the rows. This makes it easier to control the later irrigations and furnishes support for the cotton plants late in the season. The ground should, of course, be stirred after each irrigation until the plants are too large to be cultivated. More frequent cultivation may be necessary in many fields, to keep

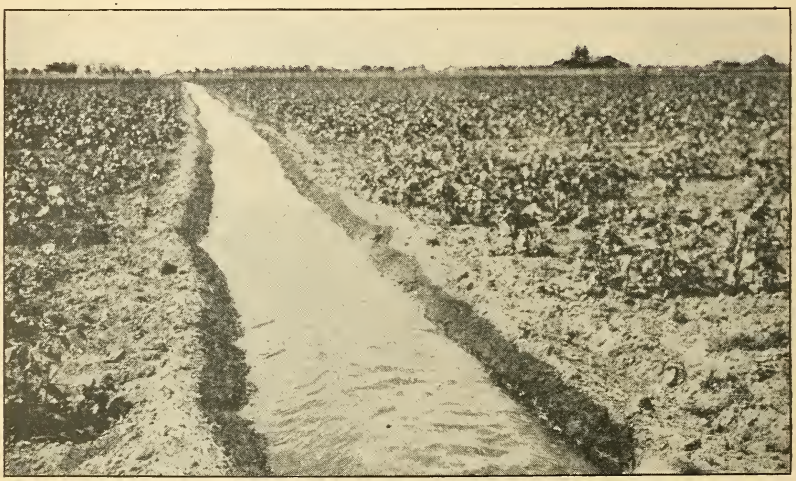

FIG. 3.—Irrigating cotton by open ditches.

down weed growth and maintain a good mulch on the surface. This is especially true early in the season, when irrigations are likely to be several weeks apart.

A riding cultivator will be found more convenient up to the time when the plants are too tall, when a 1-horse walking cultivator must be used. These late cultivations should also be shallow, so as not to interfere with surface roots.

THINNING.

Under normal conditions in the San Joaquin Valley Pima cotton is thinned when the plants are from 8 to 12 inches tall, leaving them 10 to 14 inches apart, depending to a large extent upon the fertility of the soil and time planted. (See figs. 3, 4, 5, and 6.) On very rich alfalfa land the plants should not be thinned until they are 10 to 16 inches tall and then spaced 12 to 14 inches in the row, whereas

on lighter or poorer soils the plants may be thinned when only 8 inches high and also left somewhat closer in the row. Experiments in the Salt River Valley have shown that large yields may be obtained from plants only 4 to 6 inches apart. Late-planted cotton grows much faster and more vigorously than cotton planted early, and for this reason there is greater need of restricting the size of the plants by leaving them closer together in the rows.

As described in several publications by Cook, delayed thinning and somewhat close spacing serve to suppress the vegetative branches, while allowing the fruiting branches to develop. As most of the close-spaced plants have only one stalk, there is less fruit per plant, but there are more plants per acre to make up the yield.

FIG. 4.—A field of Pima cotton just before thinning.

Moreover, the crop matures earlier, is easier to pick, and there is not nearly so much injury from early frosts.[6]

Another very important reason for delayed thinning is that it allows time for the plants to become well established and furnishes an opportunity to eliminate the weaker or inferior plants when thinning.

The ideal way to thin cotton is to pull the plants by hand, and some of the best farmers in the San Joaquin and Salt River Valleys use this method as a means of preserving the best plants and assuring a more regular stand than can be had by "chopping."

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[6] Cook, O. F. A new system of cotton culture. *In* U. S. Dept. Agr., Bur. Plant Indus. Cir. 115, pp. 15–22. 1913.

——— Single-stalk cotton culture. U. S. Dept. Agr., Bur. Plant Indus. [Doc.] 1130, 11 p., 12 fig. 1914.

Meade, Rowland M. Single-stalk cotton culture at San Antonio. U. S. Dept. Agr. Bul. 279. 1915.

IRRIGATION.

Since the need of irrigation depends upon the soil and climatic conditions, it is impossible to give any set rules stating when and how often to irrigate cotton. It is possible, however, to state a few principles which can be applied to most soils in the San Joaquin Valley.

As noted earlier in this circular, the soil should be thoroughly saturated with water before planting; then under normal conditions on the average soil it will not be necessary to irrigate again for several weeks, or before the plants are several inches high, though in many instances water is needed when the plants are only 2 or 3

FIG. 5.—Section of a row of cotton shown in figure 4.

inches high. This is especially true on light sandy soils after a hot drying wind, which may dry out the soil below the young taproots; but after the roots have become well established it is desirable to withhold water as long as possible without actually stunting the plants, especially on rich soil where there is danger of overluxuriant growth. Very little cotton in the San Joaquin Valley has been damaged by overirrigating, and there is less danger of rank growth than in the hotter valleys of California and Arizona. Much of the land in the San Joaquin Valley is sandy, which provides good drainage, and the cooler weather has a tendency to hold back or restrict the vegetative growth of the plants, though allowing as early and regular development of fruit.

On some of the soils in the San Joaquin Valley having a high water-holding capacity, crops of cotton have been grown with only one or two irrigations, and others having a high water table have

gone through an entire season without a single irrigation. On the other hand, the lighter and more open soils may require an early irrigation, and water may be needed as often as every 10 days or 2 weeks during the height of the growing and fruiting season.

Neither the character of the soil, the apparent amount of moisture in the soil, nor the number of days since the last irrigation gives a definite indication of the need of water. The condition of the plants must be the guide. Irrigation is not required so long as the plants are growing vigorously. Lack of water is indicated by the wilting or drooping of the leaves in the hot hours of the day, but ordinarily it is best to delay irrigation until the leaves show signs of wilting before noon. A slight wilted effect on a very hot day does not necessarily

FIG. 6.—The same row of Pima cotton shown in figure 5 after thinning.

indicate the need of water, especially if the hot weather comes on somewhat suddenly after a period of cool weather. When the change from cool to hot weather is very abrupt and the difference between day and night temperature is great, the plants may require two or three days to adjust themselves. Rather severe wilting under such conditions occurred in the season of 1920, and some of the farmers were panic-stricken, even to the extent that many acres of good cotton were plowed up and reseeded, which was an unnecessary expense and loss to the farmers, for other parts of the same fields recovered completely and produced more than the replanted areas.

After flowering begins, which will ordinarily be early in July, the plants should not be allowed to wilt to any great extent. It is then that the plants begin to use the maximum quantity of water, and after they begin to need an irrigation neglect for only a few days may result in serious loss. If cotton suffers for water in July

or August the entire crop is likely to be affected both in yield and quality of staple. In addition to the blasting of buds, the bolls are not fully developed and do not open well, which makes picking more difficult.

LATE IRRIGATION.

It is a mistake to neglect irrigation during the latter part of the growing season. "When the flowers can be seen above the crowns of the plants and a decided yellow color is noted in looking out over the field, it is evident that irrigation has been postponed too

FIG. 7.—The first commercial field of Pima cotton in the San Joaquin Valley, growing near Bakersfield, Calif., September 16, 1918.

long."[7] The above rule holds good in the San Joaquin Valley until the middle of September, and even after that date the plants should not be allowed to wilt for lack of water. Vigorous growth of the plants is not desirable after the first of September, and water should be used sparingly, but enough should be applied to keep the plants in a healthy condition and to take full advantage of favorable weather for maturing as many bolls as possible. (See figs. 7 and 8.) Lack of water may force an earlier opening of some of the bolls, but it is not desirable to make plants wilt or the lower leaves wither and fall. This is too severe a check and will injure many of the bolls by forcing them to open prematurely, thus impairing

[7] Hudson, E. W. Growing Egyptian cotton in the Salt River Valley, Arizona. U. S. Dept. Agr., Farmers' Bul. 577, 8 p. 1914.

the quality of the lint, as well as causing buds and young bolls to shed if water is applied later.

The prevailing idea that water should be withheld from cotton, regardless of soil and climatic conditions, after the first of September in order to make the bolls open does not lead to the best results. It is true that if no more water is given after this date, a picking can ordinarily be made somewhat earlier, but if the plants have been allowed to wilt and dry up in the meantime the bolls will not open normally, but will be poorly developed and shriveled, which makes picking very difficult and the fiber inferior. It is often desirable to irrigate once and sometimes twice after the first picking.

FIG. 8.—A field of Pima cotton near Arvin, Calif., in early September, 1918. Note its uniformity.

In case of very rank plants, especially on the heavier types of soil, more care should be used in applying the late irrigations, for if an excess of moisture is stored in the soil it will cause the bolls to be later in opening, and those nearest the ground may mildew or rot. It should be remembered that the soil and climatic conditions govern to a large extent the number of irrigations to be given during the growing season and also determine how late water should be applied. Also it must be remembered that bolls that are set after the first of September are in danger of being killed by early frosts in short seasons. Early in the season only 20 to 25 days may elapse between the square and the flower, and only 42 to 50 days between the flower and the open boll, whereas with late bolls the period of development is much longer, often 80 to 100 days. A constant supply of moisture must be maintained in the soil in order to produce normal development and opening of the bolls. (See figs. 9 and 10.)

FIG. 9.—Pima cotton, near Fresno, Calif. Note the length of the low fruiting branches. September 17, 1920.

FIG. 10.—Pima cotton badly lodged on account of a heavy crop of fruit. September 17, 1920.

FIG. 11.—Typical Pima Egyptian cotton plant in the San Joaquin Valley, September 17, 1920.

PICKING.

Cotton differs from many farm products in being less perishable and does not have to be harvested as soon as the bolls are open. However, to get the best results picking should begin just as soon as enough cotton is open to give the pickers a living wage, which is when there are 8 to 10 open bolls per plant with a normal spacing of 12 inches. With cotton planted early, picking begins between September 15 and October 1, but many late-planted fields are not ready to pick until the middle of October. (See fig. 11.)

To get the highest grade, Pima cotton should be picked three times, keeping each picking separate, because marked differences may be found when the grading is carefully done. The later pickings usually contain more broken leaves and other particles of trash, which tend to produce a lower grade of cotton. Also the last picking is likely to contain a lot of immature fiber, which is weak and of very inferior grade. Frosted cotton should never be mixed or ginned with the earlier pickings. After a freeze occurs the field should be gone over as soon as possible before the later bolls are forced open. If these latter are picked with the good cotton the lowering of the grade may occasion serious loss.

Light frosts late in the season may do no damage to the bolls and often prove an advantage, especially in rank cotton where the foliage is so dense that the sunshine can not reach the bottom bolls. The frost merely singes the leaves, making them drop, thereby allowing sunshine to reach the bottom of the plants and opening up the bolls.

To command the very best price, all varieties of cotton should be picked clean. This is especially true of Pima Egyptian cotton, because as yet no adequate cleaning device has been found which can be attached to the roller gins. Pickers accustomed to short cotton will often object at first to the special demand made upon them to keep the Pima cotton clean, but after a little experience they find that it is not difficult to keep out the broken leaves and bracts. Extra care for clean picking is justified by the higher price received for picking Pima—usually double that received for picking short cotton. Good pickers may average more than 125 pounds per day in well-grown fields of Pima cotton, while in exceptional cases more than 200 pounds have been gathered by experienced pickers. Beginners may average only 50 to 60 pounds, or less, in some fields. The following weights of 100-boll samples from 10 fields of Pima cotton in 1920 show that there are practical differences in the number of bolls that must be picked in gathering a pound of cotton, as affected by conditions of growth.

District.	Weight of 100 bolls, grains.	Number of bolls per pound.
Arvin, Kern County (Alfalfa land, well grown.)	6,640.5	105.3
Arvin, Kern County (Alfalfa land, stable manure.)	6,542.0	107.0
Shafter, Kern County (Bean land, well grown.)	6,187.7	113.1
Wasco, Kern County (Alfalfa pasture land, well grown.)	6,146.3	113.8
Fresno, Fresno County (Alfalfa pasture land, well grown.)	6,047.9	115.6
Wasco, Kern County (Well grown.)	5,842.2	119.7
Wasco, Kern County (Heavy soil.)	5,763.2	121.1
Wasco, Kern County (Suffered slightly for water.)	5,402.7	129.5
Shafter, Kern County (Small plants, medium conditions, hardly enough water.)	4,954.2	141.3
Edison, Kern County (Small plants, grown on hardpan land, not enough water.)	4,837.8	144.7

Poorly grown cotton or cotton which has suffered severely for the lack of water should also be picked and ginned separately, to avoid injuring the grade of the fiber.

Pima cotton should never be piled on the ground or left exposed in the field, but housed in a dry place. A little rain while the cotton is still in the bolls does very little damage, but considerable damage often results from a heavy rain beating down on a big pile of cotton. Dust and soil particles are dissolved, and the cotton may be stained several inches deep. Wet cotton should not be picked, but if only a little damp from a heavy fog or dew, picking need not wait, provided the cotton is spread out in the sun to dry before being tramped down in a pile. If thoroughly dry when piled up, seed cotton can be tramped down hard and will remain indefinitely without danger of heating, provided it is well protected and on a dry floor.

GINNING.

In order to obtain the highest grade from Pima cotton a roller gin must be used to separate the fiber from the seed. The process is slower than with Upland cotton and requires an expert mechanic or ginman to keep the gins in proper adjustment and operate the ginning plant. As already stated, a roller gin is not supposed to clean all the trash from the lint, but a good ginman can adjust the feeders so as to shake out much of the trash before the cotton drops to the gin. It is very important that no cracked or mashed seed pass through with the lint, because this injures the grade as much as careless picking.

The bales should be completely covered with heavy burlap, labeled, and an adequate sample taken from each bale before it goes to the press, so that buyers will not have to cut the bales to establish their grades.

LIST OF PUBLICATIONS BEARING ON EGYPTIAN-COTTON GROWING IN THE SOUTHWESTERN STATES.

The following is a list of publications dealing with the activities of the United States Department of Agriculture in connection with the establishment of Egyptian-cotton growing in the Southwest. Several of the publications listed do not deal directly with Egyptian cotton, but are included because they describe different phases of the investigations which have formed the basis for the establishment of this industry.

Egyptian cotton in the southwestern United States. By Thomas H. Kearney and William A. Peterson. Bureau of Plant Industry Bulletin 128. Issued June 13, 1908.

Suppressed and intensified characters in cotton hybrids. By O. F. Cook. Bureau of Plant Industry Bulletin 147. Issued April 7, 1909.

Experiments with Egyptian cotton in 1908. By Thomas H. Kearney and William A. Peterson. Bureau of Plant Industry Circular 29. Issued April 16, 1909.

A study of diversity in Egyptian cotton. By O. F. Cook, Argyle McLachlan, and R. M. Meade. Bureau of Plant Industry Bulletin 156. Issued July 24, 1909.

Local adjustment of cotton varieties. By O. F. Cook. Bureau of Plant Industry Bulletin 159. Issued September 28, 1909.

Origin of the Hindi cotton. By O. F. Cook. Bureau of Plant Industry Circular 42. Issued December 11, 1909.

Mutative reversions in cotton. By O. F. Cook. Bureau of Plant Industry Circular 53. Issued March 21, 1910.

Cotton selection on the farm by the characters of the stalks, leaves, and bolls. By O. F. Cook. Bureau of Plant Industry Circular 66. Issued August 13, 1910.

Breeding new types of Egyptian cotton. By Thomas H. Kearney. Bureau of Plant Industry Bulletin 200. Issued December 23, 1910.

Dimorphic branches in tropical crop plants: Cotton, coffee, cacao, the Central American rubber tree, and the banana.. By O. F. Cook. Bureau of Plant Industry Bulletin 198. Issued January 14, 1911.

Hindi cotton in Egypt. By O. F. Cook. Bureau of Plant Industry Bulletin 210. Issued May 11, 1911.

Arrangement of parts in the cotton plant. By O. F. Cook and R. M. Meade. Bureau of Plant Industry Bulletin 222. Issued October 3, 1911.

Dimorphic leaves of cotton and allied plants in relation to heredity. By O. F. Cook. Bureau of Plant Industry Bulletin 221. Issued November 22, 1911.

Cotton improvement on a community basis. By O. F. Cook. Yearbook, U. S. Dept. of Agriculture, for 1911, pp. 397–410.

Suggestions on growing Egyptian cotton in the Southwest. By Carl S. Scofield. Bureau of Plant Industry Document 717. Issued January 9, 1912.

Results of cotton experiments in 1911. By O. F. Cook. Bureau of Plant Industry Circular 96. Issued July 17, 1912.

The branching habits of Egyptian cotton. By Argyle McLachlan. Bureau of Plant Industry Bulletin 249. Issued September 20, 1912.

Improved methods of handling and marketing cotton. By Charles J. Brand. Yearbook, U. S. Dept. of Agriculture, for 1912, pp. 443–462.

Morphology of cotton branches. By O. F. Cook. Bureau of Plant Industry Circular 109, pp. 11–16. Issued January 4, 1913.

Heredity and cotton breeding. By O. F. Cook. Bureau of Plant Industry Bulletin 256. Issued January 13, 1913.

Preparation of land for Egyptian cotton in the Salt River Valley, Arizona. By E. W. Hudson. Bureau of Plant Industry Circular 110, pp. 17–20. Issued January 18, 1913.

Fiber from different pickings of Egyptian cotton. By Thomas H. Kearney. Bureau of Plant Industry Circular 110, pp. 37–39. Issued January 18, 1913.

Egyptian cotton as affected by soil variations. By Thomas H. Kearney. Bureau of Plant Industry Circular 112, pp. 17–24. Issued February 8, 1913.

A wild host plant of the boll weevil in Arizona. By O. F. Cook. Science, n. s., v. 37, pp. 259–261. Issued February 14, 1913.

A new system of cotton culture. By O. F. Cook. Bureau of Plant Industry Circular 115, pp. 15–22. Issued March 1, 1913.

The fundamentals of crop improvement. By W. T. Swingle. Bureau of Plant Industry Circular 116, pp. 3–10. Issued March 8, 1913.

The abortion of fruiting branches in cotton. By O. F. Cook. Bureau of Plant Industry Circular 118, pp. 11–16. Issued March 22, 1913.

Leaf-cut, or tomosis, a disorder of cotton seedlings. By O. F. Cook. Bureau of Plant Industry Circular 120, pp. 29–34. Issued April 5, 1913.

Factors affecting the production of long-staple cotton. By O. F. Cook. Bureau of Plant Industry Circular 123, pp. 3–9. Issued April 26, 1913.

Egyptian cotton culture in the Southwest. By Carl S. Scofield. Bureau of Plant Industry Circular 123, pp. 21–28. Issued April 26, 1913.

Agriculture on the Yuma Reclamation Project. By Carl S. Scofield. Bureau of Plant Industry Circular 124, pp. 3–8. Issued May 3, 1913.

Cotton farming in the Southwest. By O. F. Cook. Bureau of Plant Industry Circular 132, pp. 9–18. Issued July 19, 1913.

The occurrence of a cotton boll weevil in Arizona. By W. Dwight Pierce. Journal of Agricultural Research, v. 1, no. 2, pp. 89–96. Issued November 10, 1913.

Seed selection of Egyptian cotton. By Thomas H. Kearney. U. S. Dept. of Agriculture Bulletin 38. Issued November 19, 1913.

Cotton as a crop for the Yuma Reclamation Project. By the Committee on Southwestern Cotton Culture. Bureau of Plant Industry Document 1009. Issued December 1, 1913.

Notes on the entomology of the Arizona wild cotton. By W. D. Pierce and A. W. Morrill. Proceedings, Entomological Society of Washington, pp. 14–36, v. 16, no. 1. Issued March 1, 1914.

The relation of cotton buying to cotton growing. By O. F. Cook. U. S. Dept. of Agriculture Bulletin 60. Issued February 16, 1914.

Growing Egyptian cotton in the Salt River Valley, Arizona. By E. W. Hudson. U. S. Dept. of Agriculture, Farmers' Bulletin 577. Issued March 14, 1914.

Mutation in Egyptian cotton. By Thomas H. Kearney. Journal of Agricultural Research, v. 2, no. 4, pp. 287–302. Issued July 15, 1914.

The wild cotton plant (*Thurberia thespesioides*) in Arizona. By Vernon Bailey. Bulletin, Torrey Botanical Club, v. 41, pp. 301–306. Issued May 29, 1914.

Single-stalk cotton culture. By O. F. Cook. Bureau of Plant Industry Document 1130. Issued December 14, 1914.

Relation of the Arizona wild cotton weevil to cotton planting in the arid West. By B. R. Coad. U. S. Dept. of Agriculture Bulletin 233. Issued May 27, 1915.

Single-stalk cotton culture at San Antonio. By Rowland M. Meade. U. S. Dept. of Agriculture Bulletin 279. Issued August 24, 1915.

Custom ginning as a factor in cotton-seed deterioration. By D. A. Saunders and P. V. Cardon. U. S. Dept. of Agriculture Bulletin 288. Issued September 7, 1915.

The handling and marketing of the Arizona-Egyptian cotton of the Salt River Valley. By J. G. Martin. U. S. Dept. of Agriculture Bulletin 311. Issued November 26, 1915.

Community production of Durango cotton in the Imperial Valley. By Argyle McLachlan. U. S. Dept of Agriculture Bulletin 324. Issued December 22, 1915.

Comparative spinning tests of the different grades of Arizona-Egyptian with the Sea Island and Sakellaridis Egyptian cottons. By Fred Taylor and William S. Dean. U. S. Dept. of Agriculture Bulletin 359. Issued March 30, 1916.

Tests of Pima Egyptian cotton in the Salt River Valley, Arizona. By Thomas H. Kearney. U. S. Dept. of Agriculture, A. & D. R. P. Circular 1. Issued December 6, 1916.

Cotton pests. By A. W. Morrill. Eighth Annual Report, Arizona Comm. Agriculture and Horticulture, pp. 45–49. Issued December 30, 1916.

A lister attachment for a cotton planter. By Stephen H. Hastings. U. S. Dept. of Agriculture, C. P. & B. I. Circular 2. Issued March 27, 1917.

A plant industry based upon mutation. By Thomas H. Kearney. In Journal of Heredity, v. 9, pp. 51–61 (1918).

Production of American Egyptian cotton. By C. S. Scofield, T. H. Kearney, C. J. Brand, O. F. Cook, and W. T. Swingle. U. S. Dept. of Agriculture Bulletin 742. Issued January 15, 1919.

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